

instruction manual



QR40-2A &
QR40-175A

**TRANSISTORIZED
DC
VARIABLE VOLTAGE
POWER SUPPLIES**



SORENSEN

A Unit of Raytheon

Richards Avenue, South Norwalk, Connecticut

MP MASTER



MA25503

GENERAL INFORMATION

PLEASE READ THIS MANUAL. We think it will help you to obtain the maximum performance from your new Sorensen instrument.

SHIPPING DAMAGE

Sometimes instruments are damaged in transit. We strongly suggest that you inspect and test your instrument as soon as you receive it. If the instrument is damaged or if it fails to operate properly, you should ask the carrier to inspect the shipment. The carrier's claim agent will prepare a report of damage which you should send to us. We will then tell you how to have the instrument repaired or replaced.

SERVICE INFORMATION

If you have any questions about the operation, repair, or servicing of a Sorensen instrument, please contact our local representatives. (A list of representatives is included with this manual.) If it is more convenient you may contact us directly at the Service Department, Sorensen, Richards Avenue, South Norwalk, Connecticut.

IMPORTANT

BE SURE TO INCLUDE THE MODEL & SERIAL NUMBER IN ALL CORRESPONDENCE CONCERNING THIS INSTRUMENT. WITHOUT THIS INFORMATION WE MAY NOT BE ABLE TO GIVE YOU PROMPT AND ACCURATE SERVICE.

RETURNS TO THE FACTORY

Should you decide to return an instrument to us for repair, please contact us for authorization to make shipment. We have a number of local service facilities in the United States and Canada which are equipped and staffed to provide you with fast, efficient service. For this reason, we reserve the right to refuse unauthorized shipments to our plant.

WARRANTY

This instrument is warranted by Sorensen/Unit of Raytheon, to be free from defects in material and workmanship. Our obligation under the warranty is limited to servicing the instrument and replacing defective parts when the instrument is returned to the factory with transportation charges prepaid. No other warranties may be implied. The period of warranty is one year after the delivery of the instrument to the original purchaser. Defects caused by improper operating conditions, accidents, misuse, negligence, and the alteration or removal of the nameplate, will void the warranty.

*With the exception of tubes and fuses.

PLEASE RETURN TO LIBRARIAN

ORG. 6-7744 M.S. 27-14

manual # III

MODELS QR40-2A, QR40-.75A, QR18-4A & QR18-1.5A RANGERS

TRANSISTORIZED DC VARIABLE
VOLTAGE POWER SUPPLIES

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SORENSEN/A UNIT OF RAYTHEON, Richards Avenue, South Norwalk, Connecticut

14-3717B

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II. SPECIFICATIONS

Sorensen Models QR40-2A, QR40-.75A, QR18-4A and QR18-1.5A Rangers are transistorized power supplies with continuously variable, wide range output. They possess extremely fast recovery time, stable regulation and unusual insensitivity to extreme input frequencies.

MODEL		QR40-2A	QR40-.75A	QR18-4A	QR18-1.5A
INPUT AC	Voltage	105 - 125 or 210 - 250 (See page 3)			
	Frequency	50, 60 or 400 cps. (See Note 1 Page 3)			
	Curr. @125V	2.2A	0.73A	2.2A	0.73A
	@250V	1.15A	0.365A	1.15A	0.365A
OUTPUT DC	Voltage	Range 0-40V		Range 0-18V	
	Current	0-2A	0-0.75A	0-4A	0-1.5A
Voltage Regulation		±(0.01% + 1MV) Line & Load Combined			
Ripple @60 Cy (RMS)		150 Microvolts		200 Microvolts	
Current Regulation		±0.15% Line & Load Combined			
Ripple Current (RMS)		30 Micro A	10 Micro A	50 Micro A	50 Micro A
Response Time		50 Micro Seconds (See Page 3)			
Current Limiting (Amps)		0.25-2.25	0.1 - 0.8	0.5 - 4.5	0.2 - 1.6
Limiting Accuracy		10 %			
Ambient Temperature		0°C (32°F) to 40°C (104°F)			
CABINET SIZE (in)	Width	17	8 1/4	17	8 1/4
	Depth	12 1/8	9	12 1/8	9
	Height	5 1/4	5 1/8	5 1/4	5 1/8
Rack Height		5 1/4	5 1/4	5 1/4	5 1/4
Weight (net)		31 Lbs.	10.75 Lbs.	31 Lbs.	10.75 Lbs.
Output Terminals		Binding posts front, terminal board rear			
Meters		Voltmeter and Ammeter (Standard 2% Accuracy)			
Protective Devices		Input Power Fuse			

SPECIFICATION NOTES

NOTE 1. INPUT CONVERSION

This unit is capable of operation at 50, 60 and 400 cps, with accommodations for 120 and 240 volt input power. The unit is shipped for 115V/60 cps input power. To convert transformer T1 to 230V/60 cps operation refer to page 4 and figure 1. below. (Remember to change the fuse rating). To convert T1 for 400 cps operation refer to figure #2 and figure #3.

NOTE 2. FREQUENCY RANGE

This unit may be operated over an input range from 50 to 400 cps., however, all specifications are only guaranteed at the nominal input frequency of 60 cps. The ripple voltage will increase as the frequency is varied from 60 cps.

NOTE 3. RESPONSE TIME

When an abrupt change occurs in the input voltage or output load an instantaneous change in output voltage occurs. This instantaneous change is quickly suppressed by the regulating action of this unit. Response time is a measure of how fast this change is suppressed. It is defined as the time necessary for the output voltage to affect a 63% recovery from the maximum deviated value, based upon a 10% line voltage change, or a 50% step change in load.

NOTE 4. CURRENT LIMIT

Output current limit can be adjusted to a minimum of 20 ma., by adjusting potentiometer R38 on the rear panel. (This will restrict the maximum upper current limit).

Fig. 1

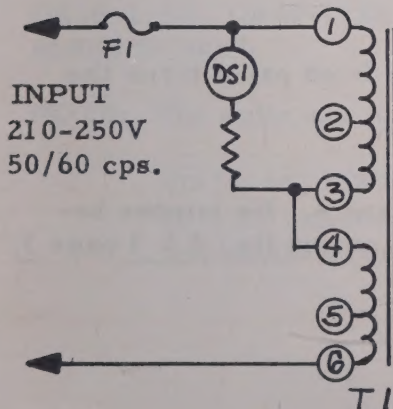


Fig. 2

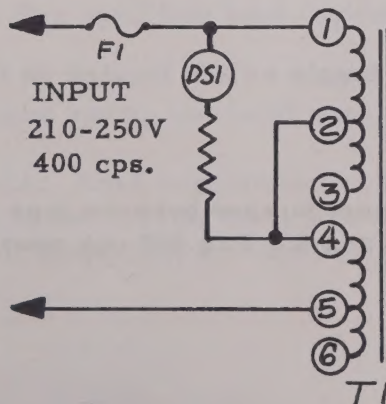
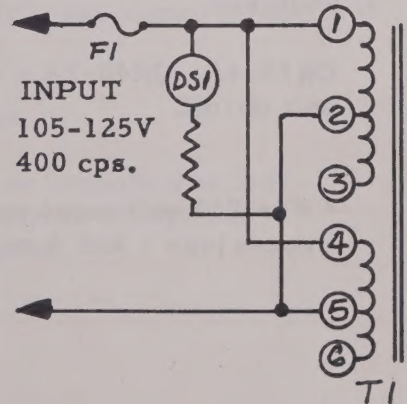


Fig. 3



III. INSTALLATION AND OPERATION

This instrument when originally purchased may be supplied self-contained for bench top operation or equipped for mounting in a standard 19" relay rack. In the event it is later desired to rack mount a self-contained unit or vice versa, this may be accomplished without difficulty. The user should contact the local representative or the Sorensen Service Department for the necessary parts and instructions.

TERMINALS AND CONTROLS

I. Input Power Connection

The input power is applied by means of a line cord utilizing a 115/230 volt polarized three-prong plug. Since the third prong of this plug is connected to the chassis, connection of the line cord to the appropriate receptacle automatically grounds the equipment. If the user does not have a three prong outlet available, he should use an adapter. The extra wire (colored green), coming out from the adapter, should be solidly grounded to the power line wiring system, preferably soldered. The aforementioned should be carried out for safety reasons.

NOTE: The input line cord and transformer are shipped set up for 50-60 cps, 105-125V single phase operation.*

2. Output Power Connections

The DC output is available at the two binding posts located on the front panel or at the terminal board located at the rear of the unit. The current limit links are located on the rear terminal board.

QR18-4A, QR40-2A - The front and rear terminals provide the means for external sensing, programming and converting the unit into a constant current regulator.

QR18-1.5A, QR40-.75A - The rear terminals provide the same function as the QR18-4A, QR40-2A.

3. Switches

QR18-4A, QR40-2A - A toggle switch located on the front panel turns the unit on/off.

* For 230 volt input connect jumper between lugs 3 and 4. No jumper between lugs 1 and 4 or 3 and 6. For 400 cps operation see fig. 2 & 3 page 3.

QR18-1.5A, QR40-.75A - A rotary switch located on the front panel performs three functions:

- a. Turns unit on/off.
- b. Inserts voltmeter into the circuit.
- c. Inserts ammeter into the circuit.

4. Pilot Light

Indicates when line power is supplied to the unit.

5. Meters

QR18-4A, QR40-2A - DC Voltmeter, indicates output voltage
DC Ammeter, indicates load currents

QR18-1.5A, QR40-.75A - A single meter indicates the output voltage and the load current.

6. Controls

- a. Output adj. - A potentiometer (R4), located on the front panel, adjusts the output voltage to any desired level.
- b. Curr. Limit - A potentiometer (R39), located on the front panel, protects the load from excessive currents, in the event of a malfunction of the load.

7. Fuses

The input power fuse protects the equipment from damage due to internal or external short circuits when the current limiting circuit is disabled.

8. Sensing

- a. Local Sensing - The load wires can be connected to either the front or rear terminals.

QR18-1.5A, QR40-.75A - For specified load regulation, the rear terminals should be used.

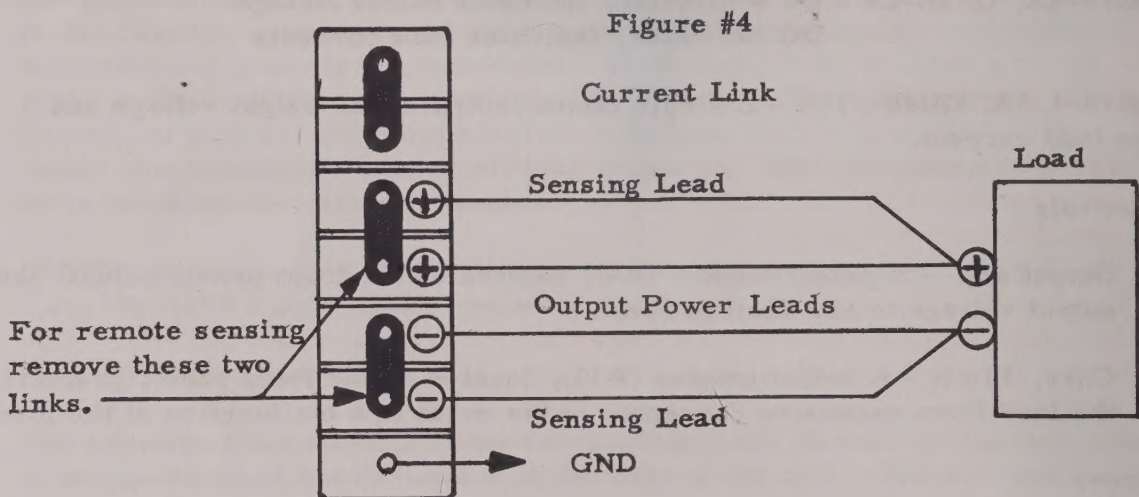
NOTE: The units are shipped set up for local sensing.

QR18-4A, QR40-2A: Load regulation (local or remote sensing) may be improved if the sensing links are removed from those terminals (front or rear) that are not being used.

- b. Remote Sensing - Remote sensing requires the removal of two shorting links, i. e., links joining minus to minus terminals and plus to plus terminals. The remote load wire and sensing leads are then connected to their respective terminals. Refer to Figure #4. They must be connected at the same side of the unit.

QR18-1.5A, QR40-.75A - Remote sensing is available only at the rear terminals.

CAUTION: Be sure that the input power is removed while converting to remote sensing.

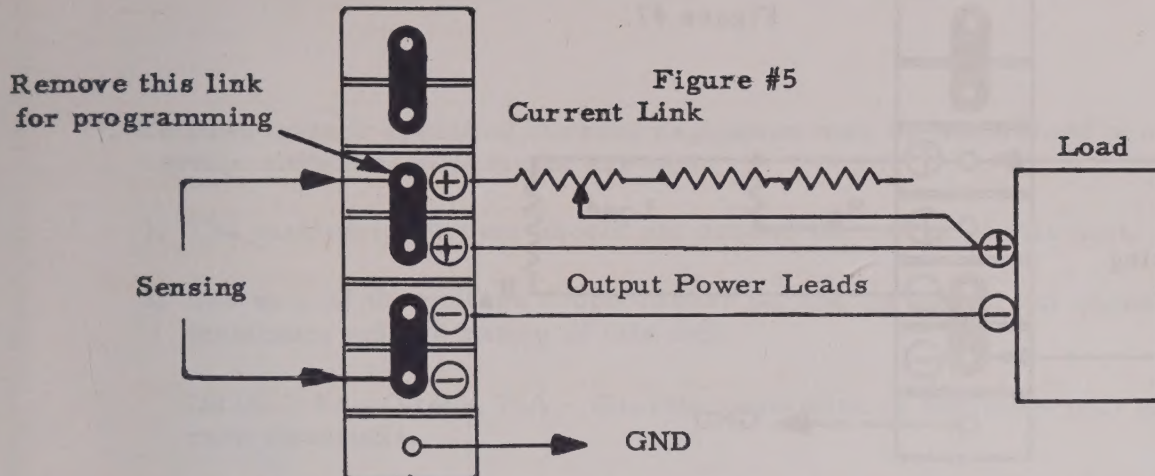


9. Programming

If step voltage changes are required at a remotely located area, the following procedure is necessary.

- Turn the output adj. potentiometer (R4) so that the output voltage is zero.
- Remove the input power, and then remove the shorting links between + output and + sense.
- Connect the desired resistance as shown in Figure #5. By employing the ratio of 100 ohm per volt, the value of the resistor can be determined.

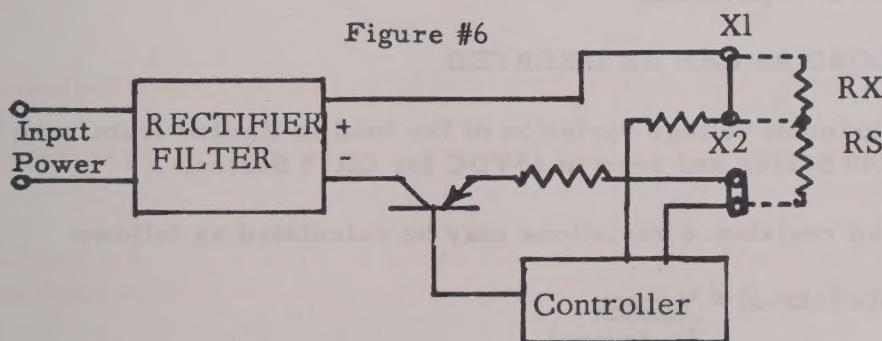
QR18-1.5A, QR40-.75A - Programming is available only at the rear terminals.



CAUTION: When programming, be sure there is no break in continuity in the resistors. An open circuit may damage the equipment.

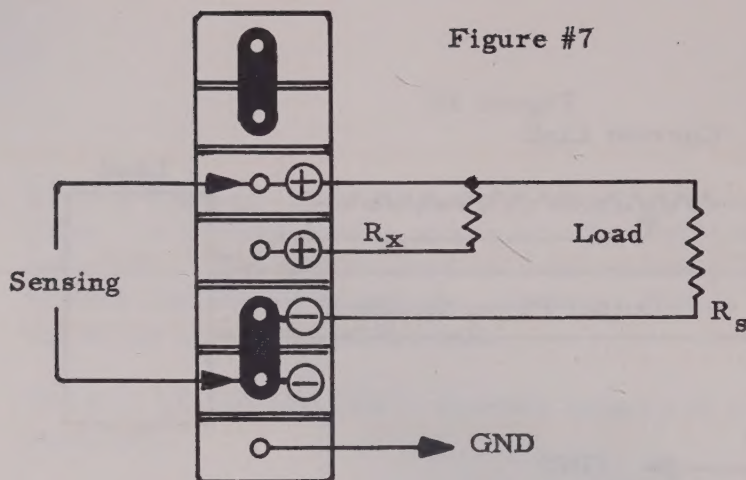
10. Current Regulation

- There are many applications where current regulation is required. This unit can be readily adapted to supply constant current requirements in the specified current range.
- Figure #6 is a simplified schematic diagram showing the QR supply delivering regulated voltage to a stable resistance R_s connected across the output terminals (with $X1$ & $X2$ shorted). If an additional load R_x is inserted between points $X1$ & $X2$, the current through R_x will be equal to the current through R_s plus whatever current is drawn by the control circuit. Since the control current is small and relatively constant and the voltage is regulated across the fixed resistor R_s , it follows that the current in R_x will be constant in spite of variations in its resistance.



To convert this unit into a constant current regulator, refer to Figure #7 for the proper hookup.

Figure #7



- c. To set up the regulator for the required current to be controlled, remove the input power from the unit. Insert resistor R_s as shown. Resistor R_x will be inserted later.

The actual resistance and wattage of R_s are computed as follows:

$$R_s (\text{ohms}) = \frac{V_{\min}}{I_L - 0.01 \text{ amps}} \quad P_{R_s} (\text{watts}) = (V_{\min}) (I_L - 0.01 \text{ amps})$$

Where R_s = Current determining resistor

I_L = Load current in amperes

P_{R_s} = Wattage in resistor R_s

$V_{\min}$ = 3 VDC for QR18 Series

$V_{\min}$ = 10VDC for QR40 Series

R_x = Load on the Power Supply

In order to keep current drift at a minimum, it is suggested that the power rating of the resistor be twice the calculated value. In addition, a low temperature coefficient wire should be used for the resistor such as Cupron Alloy 45 or equivalent.

NOW LOAD R_x CAN BE INSERTED

- d. The maximum voltage variation of the load is limited from zero to 30VDC for QR40 Series and zero to 15VDC for QR18 Series.

The load resistance variations may be calculated as follows:

$$\text{Max. } R_x (\text{ohms}) = \frac{V_{\max.}}{I_L (\text{amps})}$$

$$\text{Min. } R_x (\text{ohms}) = \text{zero ohms}$$

- e. Remove the input power from the unit. Remove the shorting link from between + DC and + sense. Insert R_x as shown in Figure #7. Make the final adjustment for the load current by means of the output adjust control (R4).

f. To summarize, specified current regulation may be maintained provided certain simple requirements are met.

1. The maximum current should not exceed the rating of this unit.
2. The sum of the voltage drops across R_s and R_x should not exceed the maximum voltage rating of this unit.

QR18-1.5A, QR40-.75A - Current regulation is available only at the rear terminals.

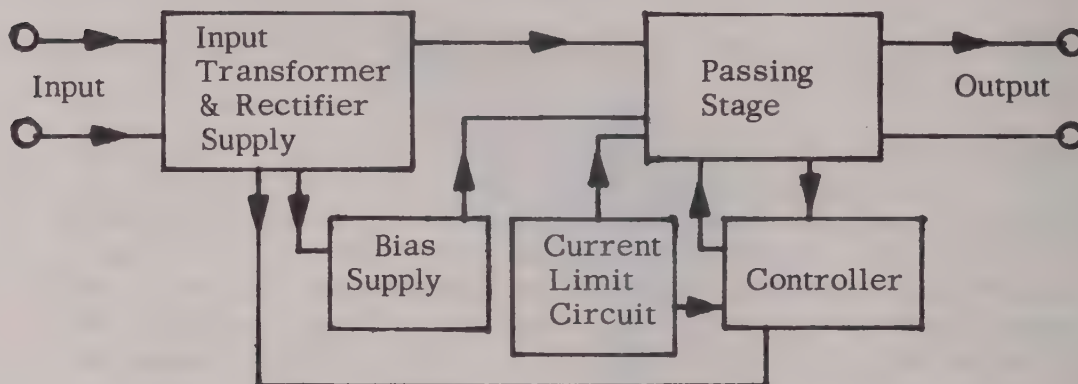
11. Current Limit Links

The links are found in the rear of the unit and are not normally removed. However, if the unit is required to regulate for a pulse load, the peak load current may exceed the maximum rating of the unit. In this case, the current limiting circuitry would prevent the unit from regulating the peak pulse currents. Therefore, the shorting links should be removed.

IV. PRINCIPLE OF OPERATION

The Q Nobatron is a regulated DC power supply, employing semi-conductors throughout. The operation of this equipment can best be understood by referring to the block diagram (Figure #8) shown below and to the schematic diagram.

Figure #8

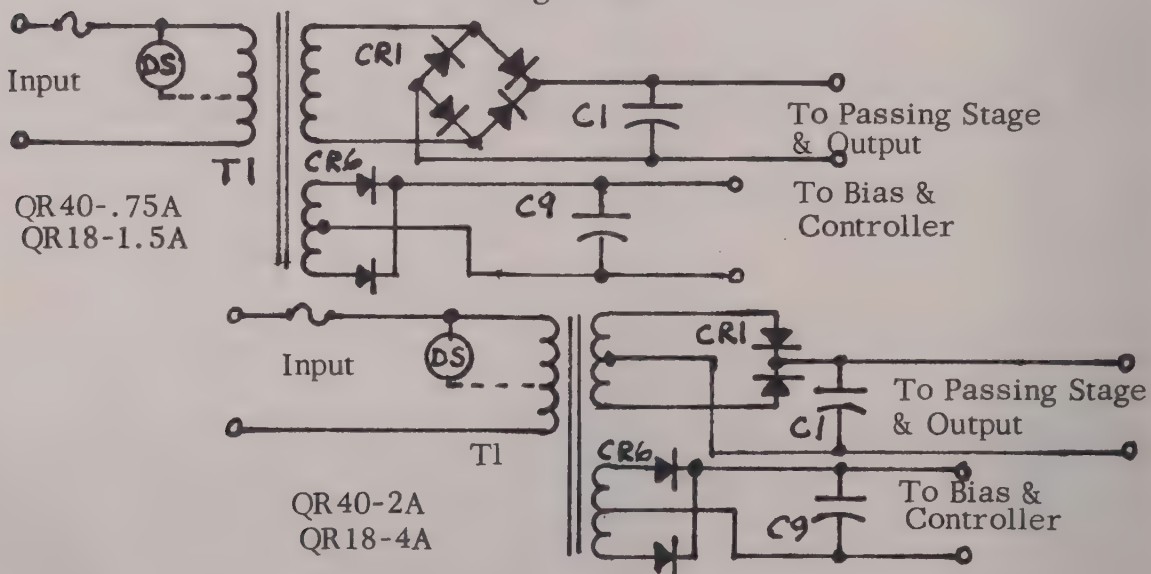


1. Input Power & Rectifier Supply

The main power supply employs bridge or full wave rectification with capacity input filtering, and produces approximately 50VDC. This voltage is fed to the series passing stage and output terminals. The auxiliary supply features full-wave rectification (CR6) with capacity input filter (C9) to supply the bias and amplifier circuits.

Primary windings of transformer T1 are so arranged that 50/60 cycle power and 400 cycle power can be employed. Refer to Figure #9 and page 3.

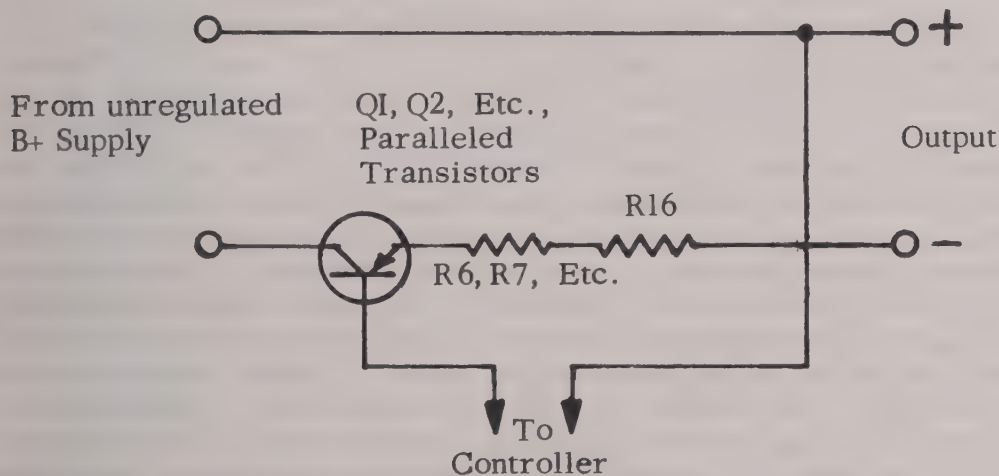
Figure #9



2. Transistor Series Passing Stage

The main power supply voltage appears across the output terminals, minus the drop across the passing transistors (Q1, Q2, etc.), resistors (R6, 7, etc.) and resistor R16. This passing stage can be thought of as a variable impedance. If the output voltage tends to rise, due to a line or load change, the passing transistor impedance increases. The result is additional transistor voltage drop, which maintains the output voltage at the preset value. Conversely, if the output voltage falls, the impedance of the transistors decrease and additional voltage would be supplied to the output terminals, thus returning the output voltage to its original level. R6, R7, etc. are emitter balancing resistors, which insure the equal distribution of the load current through each transistor. Refer to Figure #10.

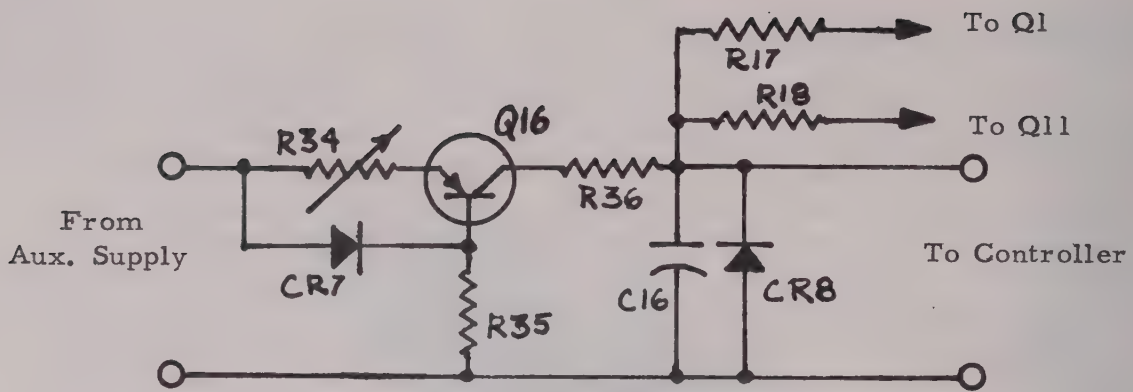
Figure #10



3. Bias Supply

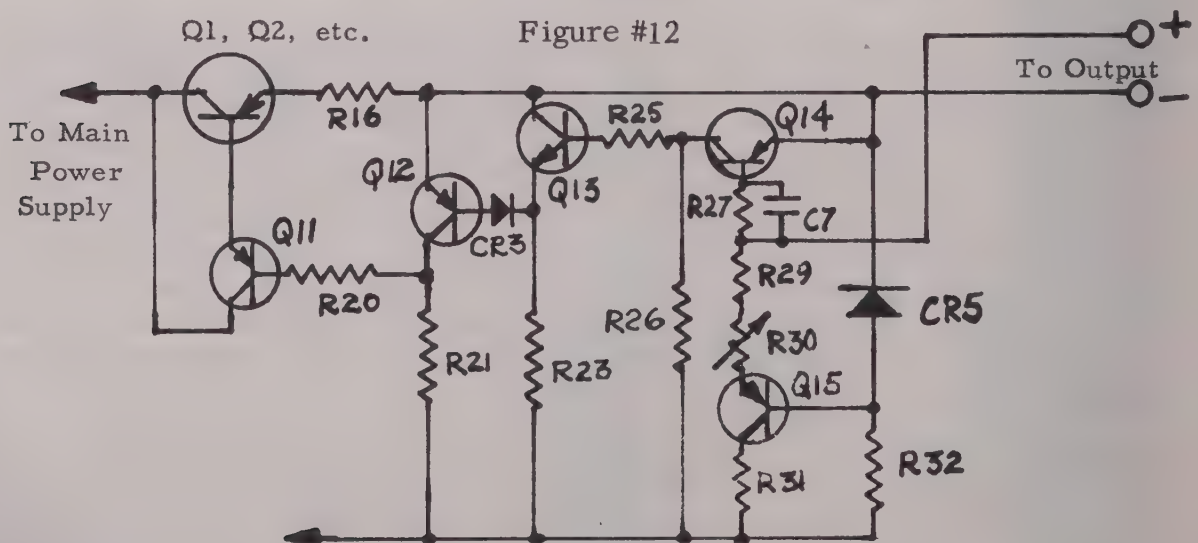
The aux. supply features full-wave rectification (CR6 Fig. 9) with capacitor input filtering (C9), which feeds the bias circuit and the control amplifier circuit. The bias voltage is obtained from resistor R36. However, this voltage could vary due to line or load changes. To stabilize the bias voltage, transistor Q16, R34, R35 and diode CR7 are added. These components are connected as shown in Figure #11 to produce a constant current regulator. Maintaining a constant current through R36 will establish a constant "bias" voltage across resistor R36. Variation in auxiliary supply voltage because of line and load changes are then dropped across Q16. Resistor R17 supplies the appropriate bias voltage to this passing transistor and R18 supplies bias voltage to transistor driver-amplifier Q11.

Figure #11



4. Controller (Sensing Circuit and Amplifier)

The sensing circuit employs a constant current reference and resistor network consisting of Q15, CR5, R4, R28, R29, R30, R31, and R32. Transistors Q11, Q12, Q13 and Q14 and the associated components amplify the error signal, which controls the impedance of the passing transistors. The theory of operation is as follows: (Refer to Figure #12). If the output voltage tends to rise, due to a line or load change, this voltage or error signal appears between the base and emitter of transistor Q14. The base tends to become more positive and the collector current of Q14 is reduced, which results in a decrease of voltage across R26. This lowers the base-emitter voltage of Q13 and increases the impedance of Q13. The increased impedance of Q13 then reduces the voltage drop across R23, which increases the forward bias of transistor Q12. The impedance of Q12 is reduced and raises the base voltage of Q11. The forward bias of Q11 is reduced and Q11 impedance increases. As a result, the passing stage's impedance increases and absorbs the extra voltage. The output voltage remains at the preset value.



5. Current Limiting Circuit

The current limiting circuit is a safety feature incorporated to protect the load against excessive currents. Refer to Figure #13.

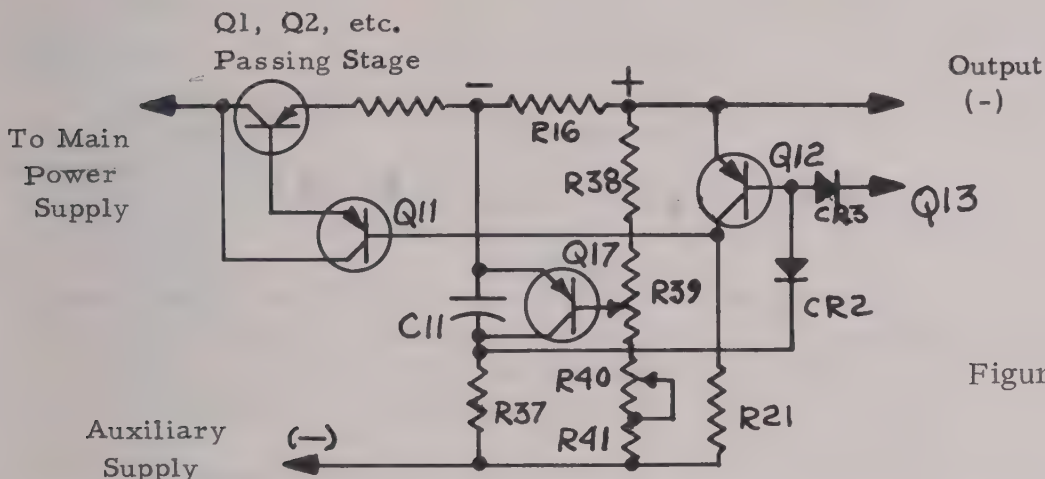


Figure #13

See Section V for the adjustment of current limiting control. Resistor R39 determines the maximum current to be delivered to the load. Assume that an overload occurred at the load. The current would tend to rise. This rise would appear across R16, with a polarity indicated in Figure #13. This would cause the impedance of transistor Q17 to increase, which in turn would cause the voltage drop across R37 to decrease. This would cause diode CR2 and transistor Q12 to conduct. As a result, the forward bias of transistor Q11 would be reduced increasing the impedance of Q11 and the passing stage transistors. This would reduce the output voltage and the short circuit current to the preset value.

V. MAINTENANCE AND REPAIR

During normal life this instrument requires no maintenance other than the care afforded similar equipment. It is suggested that excessive dust and any other foreign matter be removed periodically, exercising care to prevent damage to the instrument by cleaning tools or excessively strong air blasts.

CAUTION: KEEP ALL LINKS TIGHT AT ALL TIMES

I. Trouble Shooting

Only qualified personnel understanding transistorized regulator circuitry should attempt the repair of this unit, if damage should occur. Major servicing should be done only by the factory or one of its representatives.

Symptom	Probable Cause	Solution
1. No Output Voltage	1. a. Blown Input fuse 1. b. Defective switch(S1)	Replace Fuse Replace Switch
2. High Output	2. a. Shorted passing stage	Check for defective transistor
3. Poor Regulation	3. a. Defective transistor in control amplifier 3. b. Defective CR5 3. c. Check voltage across R36, it should be approximately 20V 3. d. Defective CR8	Check Q11, 12, 13, 14, and 15 Replace If not correct, readjust R34 Replace
4. No current limiting	4. a. Defective resistors R38, 39, 40, 41 4. b. Defective transistor Q17 4. c. Check link (Current) 4. d. Defective CR2, CR3, & (CR10, CR11 in QR40-2A, QR18-4A)	Replace Replace Adjust Replace
5. High Output Ripple	5. a. Defective control amplifier. Check transistors & components. 5. b. Defective filter capacitor	Replace as required Replace as required

2. Adjustment Procedure

A. Bias Supply Adjustment

- (1) Apply input voltage to the unit. Place a DC voltmeter across resistor R36. Adjust resistor R34 to produce a 20 volt $\pm 2\%$ reading across R36.

B. Output Range Adjustment

- (1) Set potentiometer R4 to 4000 ohms for QR40 Series, and to 1800 ohms for QR18 Series.

- (2) Adjust potentiometer R30 (located at the rear of the unit) for a reading at the output terminals of 40 volts DC for QR40 Series or 18 volts DC for QR18 Series.
- (3) Turn the Output Adjust potentiometer R4 counter clockwise and note that the output voltage goes approximately 0.15 volts negative.

C. Current Limiting Range Adjustment

- (1) Set potentiometers R38 and R40 to their midway settings. Set "CUR LIMIT" potentiometer R39 (front panel control) fully clockwise.
- (2) Turn unit on and adjust potentiometer R4 to produce, at the output terminals, 40 VDC for QR40 Series or 18 VDC for QR18 Series.
- (3) Set meter switch (front panel control) to the current meter position.
- (4) Adjust potentiometer R40 (located at the rear of the unit) to produce the following approximate load currents:*

2.4 Amps	Model QR40-2A
850 Milliamps	Model QR30-.75
4.8 Amps	Model QR18-4A
1.75 Amps	Model QR18-1.5A

10.2 Ω

- (5) Using the same external load used in step (4), set potentiometer R39 (front panel) to the lowest calibration line. Adjust potentiometer R38 (located at the rear of the unit) to produce a reading through the load of:

250 Milliamps	Model QR40-2A
100 Milliamps	Model QR40-.75A
500 Milliamps	Model QR18-4A
200 Milliamps	Model QR18-1.5A

- (6) Next turn potentiometer R39 to the highest calibration line. Adjust potentiometer R40 to produce a reading through the load of:

2.25 Amps	Model QR40-2A
800 Milliamps	Model QR40-.75A
4.5 Amps	Model QR18-4A
1.6 Amps	Model QR18-1.5A

* Load resistors used should be at least double the power (wattage) anticipated.

NOTES

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
C1		CAPACITOR, 2500 MFD, 50VDC, + 150%, -10%	MAIN SUPPLY FILTER	24-2228	AEROVOX TYPE "E"
C2		CAPACITOR, 20 MFD, 100 VDC, + 150%, -10%	RIPPLE BY PASS CAPACITOR	24-2203	CORNELL DUBILIER #NLW357
C3		CAPACITOR, 1000 MFD, 50 VDC, + 150%, -10%	OUTPUT FILTER CAPACITOR	24-2227	AEROVOX TYPE "QE"
C4		CAPACITOR, .022 MFD, 100VDC, ±10%	STABILIZING CIRCUIT CAPACITOR	24-2400	CORNELL DUBILIER #WMF 1S22E
C5, C1		CAPACITOR, .1 MFD, 100 VDC ±10%	STABILIZING CIRCUIT CAP.	24-2401	CORNELL DUBILIER #WMF1P1E
C7		CAPACITOR, .047 MFD, 100 VDC, ±10%	STABILIZING CIRCUIT CAP.	24-2402	CORNELL DUBILIER #WMF1S47F
C8		CAPACITOR, .1 MFD, 400 VDC ±10%	RIPPLE SUPPRESSION CAPACITOR	24-2102	CORNELL DUBILIER #TWJ4P1E4P
C9		CAPACITOR, 150 MFD, 100 VDC	AUXILIARY SUPPLY FILTER	24-2205	CORNELL DUBILIER #BEX10773
C10		CAPACITOR, 40 MFD, 50 VDC, + 150%, -10%	REFERENCE FILTER CAPACITOR	24-2207	CORNELL DUBILIER #NLP345
C11		CAPACITOR, .22 MFD, 100 VDC, ±10%	CURRENT STABILIZATION	24-2403	CORNELL DUBILIER #WMF1P22E

FOR REFERENCE
SCHEMATIC DRAWING
200-3002SORENSEN - A UNIT OF RAYTHEON CO.
RICHARDS AVENUE, SO. NORWALK, CONN.

LIST NO. A14-3902

SHEET 1 OF 6

PREPARED R.B. DATE 12-26-61

APPROVED BY *[Signature]* 1-3-62

MODEL WR 10-100
 SERIAL NO. 160 TO

CHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
2		CAPACITOR, 20 MFD, 50 VDC	OSCILLATION SUPPRESSOR	24-782	CORNELL DUBILIER #NLW-2050
CR1 A, B, C, D	4	RECTIFIER, SILICON, 100 V, (1N1563A)	MAIN POWER SUPPLY RECTIFIER	26-115	MOTOROLA
CR2	1	RECTIFIER, SILICON, 1N2482	BLOCKING RECTIFIER	26-887	SARKES TARZIAN TYPE F-2
CR3	1	RECTIFIER, SILICON, 1N2482	BLOCKING RECTIFIER	26-887	SARKES TARZIAN TYPE F-2
CR4	1	RECTIFIER, SILICON, 1N2482	SURGE SUPPRESSION	26-887	SARKES TARZIAN TYPE F-2
CR5	1	RECTIFIER, ZENER, 3/4 WATT, (1N2621)	REFERENCE DIODE	26-202	DICKSON ELECTRONICS TYPE 3/4 T50A9.3
CR5A, B	2	RECTIFIER, 1N2483	AUXILIARY SUPPLY RECTIFIER	26-813	SARKES TARZIAN TYPE F-4
CR7	1	RECTIFIER, SILICON, 1N1217	CONSTANT CURRENT CIRCUIT	26-864	WESTINGHOUSE 320A
CR8	1	RECTIFIER, ZENER, 10 WATT, (1N2988A)	PRE REGULATOR DIODE	26-201	DICKSON ELECTRONICS #10Z27D10
CR9	1	RECTIFIER, GERM. DIODE, 1N2326	COMPENSATION DIODE	26-108	RCA TYPE 1N2326
DS1	3	PILOT LAMP, RED	POWER "ON" INDICATOR	43-308	INDUSTRIAL GROUP 1V-B

REPLACEMENT PARTS LIST

MODEL QR 18-1.5 A

SERIAL NO. 150 TO

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
F1	5	FUSE, 1 AMP, 250V, 3AG FUSE HOLDER, 3AG	INPUT FUSE	42-2800 42-459	LITTLEFUSE #314001 LITTELFUSE #342012
M1		METER, 0-20 VDC, 0-2 A	VOLTMETER & AMMETER	94-391	MARION TYPE MM2
Q1 THRU Q4	4	TRANSISTOR	PASSING TRANSISTOR	18-025	DELCO 2N 441 SORENSEN & Co., INC.
Q11	1	TRANSISTOR	DRIVER AMPLIFIER	18-080	CLEVITE 2N1760
Q12	1	TRANSISTOR, PNP	AMPLIFIER	18-075	MOTOROLA 2N1193
Q13	1	TRANSISTOR	AMPLIFIER	18-017	SYLVANIA ELECTRIC 2N214
Q14	1	TRANSISTOR, PNP	INPUT AMPLIFIER	18-075	MOTOROLA 2N1193
Q15	1	TRANSISTOR, PNP	CONSTANT CURRENT REFERENCE AMPLIFIER	18-076	RCA 2N270
Q16	1	TRANSISTOR	CONSTANT CURRENT PWR AMP.	18-080	CLEVITE 2N1760
Q17	1	TRANSISTOR, PNP	CURRENT LIMITER AMPLIFIER	18-076	RCA 2N270

MODEL QR 18-1.5 A

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SERIAL NO. ____ TO ____

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
R1		RESISTOR, 25 $\sim$, 3W, $\pm 5\%$	MAIN SUPPLY BLEEDER	28-575	WARD LEONARD TYPE 3X-25
R2		RESISTOR, .2 $\sim$ 2W, $\pm 1\%$	AMMETER SHUNT RESISTOR	28-898	SAGE ELECTRIC #SA2W
R3		RESISTOR, 300 $\sim$, 1/2W, $\pm 1\%$	VOLTAGE DIVIDER	27-1106	INT. RESISTOR TYPE DCC
R4		POT., 180 & 1.8K, 2 W.	OUTPUT VOLT ADJUST, DUAL	29-390	CLAROSTAT TYPE 43
R5		RESISTOR, 19.9K $\sim$, 1/2W, $\pm 1\%$	METER MULTIPLIER	28-1032	INT. RESISTOR TYPE DCC
R6 THRU R9		RESISTOR 2.5 $\sim$ 3 W, $\pm 5\%$	PASSING STAGE BALANCE	28-1031	WARD LEONARD TYPE 3x2.5
R16		RESISTOR, 0.2 $\sim$ 2W, $\pm 1\%$	CURRENT LIMITING SENSING	28-898	SAGE ELECTRONICS #SA2W
R17		RESISTOR, 700 $\sim$, 3W, $\pm 5\%$	POWER AMPLIFIER BIAS	28-822	WARD LEONARD TYPE ZTC
R18		RESISTOR, 10K $\sim$, 1/2W, $\pm 10\%$	Q11 REVERSE BIAS	27-133	ALLEN BRADLEY #EB1031
R19		RESISTOR, 15K, $\sim$, 1/2W, $\pm 10\%$	AMPLIFIER BASE COMPENSATION	27-179	ALLEN BRADLEY #EB1531
R20		RESISTOR, 150 $\sim$, 1/2W, $\pm 10\%$	STABILIZING CIRCUIT	27-183	ALLEN BRADLEY #EB1511
R21		RESISTOR, 1K $\sim$, 2W, $\pm 10\%$	Q12 COLLECTOR RESISTOR	27-302	ALLEN BRADLEY #HB1021

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 SERIAL NO. TO

SHEET OF

CHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
R22		RESISTOR, 100 $\sim$, 1/2W, $\pm 10\%$	STABILIZING CIRCUIT	27-173	ALLEN BRADLEY #EB1011
R23		RESISTOR, 6.8K $\sim$, 1/2W, $\pm 10\%$	Q13 EMITTER RESISTOR	27-185	ALLEN BRADLEY #EB6821
R24		RESISTOR, 100 $\sim$, 1/2W, $\pm 10\%$	STABILIZING CIRCUIT	27-173	ALLEN BRADLEY EB1011
R25		RESISTOR, 1K $\sim$, 1/2W, $\pm 10\%$	VOLTAGE DIVIDER	27-103	ALLEN BRADLEY #EB1021
R26		RESISTOR, 15K $\sim$, 1/2W, $\pm 10\%$	VOLTAGE DIVIDER	27-179	ALLEN BRADLEY #EB1531
R27		RESISTOR, 560 $\sim$, 1/2W, $\pm 10\%$	Q14 BASE RESISTOR	27-1103	ALLEN BRADLEY #EB5611
R28		RESISTOR, 430 $\sim$, 1/2W, $\pm 5\%$	TEMP COMPENSATION SHUNT	27-1104	ALLEN BRADLEY #EB4315
R29		RESISTOR, 270 $\sim$, 12W, $\pm 5\%$	TEMP COMPENSATION	28-1000	INT. RESISTANCE TYPE 1-3/4A
R30		POTENTIOMETER, 2K $\sim$, 2W $\pm 10\%$	OUTPUT RANGE ADJUST	29-358	CLAROSTAT 43 SERIES
R31		RESISTOR, 1K $\sim$, 1/2W $\pm 10\%$	Q15 COLLECTOR RESISTOR	27-103	ALLEN BRADLEY #EB1021
R32		RESISTOR, 1.8K $\sim$, 1/2W $\pm 10\%$	REFERENCE BRIDGE RESISTOR	27-176	ALLEN BRADLEY #EB1821
R33		RESISTOR, 750 $\sim$, 10W, $\pm 5\%$	REFERENCE BLEEDER	27-544	WARD LEONARD #10F750
R34		POTENTIOMETER, 5 $\sim$, 2 W, $\pm 20\%$	CONSTANT CURRENT ADJUST	29-346	C.T.C. CORP.
R35		RESISTOR, 6.8K $\sim$, 2W, $\pm 5\%$	Q16 BASE RESISTOR	27-352	ALLEN BRADLEY #HB6825

MODEL 160
SERIAL NO. 160 TO 160

SCHEMATIC SYMBOL	RECOMM. SPARES	DESCRIPTION	FUNCTION	SORENSEN PART NO.	MANUFACTURER
R36		RESISTOR, 150 $\sim$, 10W, $\pm 5\%$	REVERSE BIAS	27-517	WARD LEONARD #10F150
R37		RESISTOR, 10K $\sim$, 1/2W, $\pm 10\%$	Q17 COLLECTOR RESISTOR	27-133	ALLEN BRADLEY # 1031
R38		POTENTIOMETER, 500 $\sim$, 2W, $\pm 10\%$	LOWER LIMIT CURRENT ADJUST	29-330	MALLORY & Co. TYPE R
R39		POTENTIOMETER, 500 $\sim$, 2W, $\pm 10\%$	CURRENT LIMITING ADJUST	29-329	MALLORY & Co. TYPE R
R40		POTENTIOMETER, 25K, 2W $\pm 10\%$	UPPER LIMIT CURRENT ADJUST	29-328	MALLORY & Co. TYPE R
R41		RESISTOR, 27K $\sim$, 1/2W, $\pm 10\%$	CURRENT LIMITER	27-110	ALLEN BRADLEY #EB2731
S1		SWITCH, ROTARY, 3 POS., 2 SECT	ON-OFF & METER SWITCH	45-248:	MALLORY #RS60-2
T1		TRANSFORMER	POWER TRANSFORMER	126-2287	SORENSEN & Co., INC.

MP MASTER



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